Prevalence Of Hypertension And Its Factors In A Particular Urban Area In Bangladesh

A project report submitted to the Department of Statistics, University of Dhaka,

as a Partial Fulfillment of the Requirements for the Degree of Bachelor of Science

Research Project

Stat H-412

SUBMITTED BY

Laboni Akter
Roll: SK-022-010
Reg: 2017-213-932

Khwaja Shamsuddoha
Roll: AK-022-035
Reg: 2017-513-957

Rabin Hossain
Roll: FH-022-046
Reg: 2017-313-968

Sabbir Al Mehedi
Roll: SM-134
Reg: 2014-716-414

SUPERVISED BY

Md. Zillur Rahman Shabuz, PhD

Associate Professor, Department of Statistics

University of Dhaka

November, 2022

November, 2022

Controller of Examination

University of Dhaka

Dhaka -1000

Bangladesh

Dear Sir,

In forwarding the project entitled, "Prevalence Of Hypertension And Its Factors In A Particular Urban Area In Bangladesh", in partial fulfillment of the requirements for the degree of Bachelor of Science (B.S.) in Statistics, University of Dhaka, I hereby certify that the four students of 4th year (Class Roll No: SK-022-010, FH-022-046, AK-022-035, SM-134) have completed the research project as a full-time students and the project embodies the result of their investigation conducted during the period they worked as a B.S. (Research project) students under our supervision.

Sincerely yours,

Md. Zillur Rahman Shabuz, PhD

Associate Professor

Department of Statistics

University of Dhaka

Dhaka – 1000

Acknowledgement

We would like to thank and show our respect and gratitude to Allah, the Almighty, for allowing us to accomplish this project.

We are indebted to our distinguished supervisor, Md. Zillur Rahman Shabuz, PhD, Associate Professor, Department of Statistics, University of Dhaka, for his vital oversight and helpful guidance. This study's topic selection was supported by his persistent encouragement, vital suggestions, and necessary corrections. We credit the timely and successful completion of this study to his constructive criticisms, ideas, and guidance.

Professor Sayema Sharmin, Chairperson of the Department of Statistics at the University of Dhaka, is to be thanked for allowing us to use the department's lecture room and computer lab for this research.

Lastly, we would like to express our profound gratitude to our parents and family members for their everlasting love, support, and encouragement throughout our whole study period at this department.

Abstract

Hypertension is a major public health concern and one of the main risk factors for several cardiovascular diseases. In Bangladesh, the prevalence of hypertension is 28.4%. This study aimed to assess the present status of hypertension and to explore the impact of several demographic, socio-economic and biological variables on hypertension. The study used the data which was collected by direct interview at Dhanmondi area of Dhaka in Bangladesh, from June 10 to July 20, 2022. We have applied univariate and bivariate analysis to explore the characteristics of variables in the sample. Finally, binary logistic regression model was employed to identify the risk factors of hypertension. The prevalence of hypertension in Dhanmondi area was 38.3%. We observed that age, income, coffee intake, family history of hypertension and heart disease are significantly associated with hypertension. Policymakers should take necessary action to advertise the necessity of reducing coffee intake and increasing physical activity through radio, television and newspaper regularly.

List of Figures

Table of Contents

1. Introduction

Hypertension, or high blood pressure, is a long-term medical disorder when the blood pressure in the arteries is consistently increased. Hypertension is a serious medical condition that significantly increases the risks of heart, brain, kidney and other non-communicable diseases (NCDs). A quiet, invisible killer, hypertension rarely manifests any signs [1].

In 2021, there were 1.28 billion adults aged 30-79 years worldwide who have hypertension, most (two-thirds) living in low- and middle-income countries [2]. Low and middle-income countries bear a large burden of cardiovascular disease (CVD). It leads to 9.4 million deaths worldwide every year due to complications of hypertension [1]. Hypertension is responsible for at least 45% of deaths due to heart disease and 51% of deaths due to stroke. In low-income South Asian countries as well, CVD has quickly emerged as a leading cause of mortality and morbidity [3]. The number of people living with hypertension is predicted to become 1.56 billion worldwide by the year 2025 [4].

In 2010, 31.1% of the world's adults had hypertension; 28.5% in high-income countries and 31.5% in low- and middle-income countries. From 2000 to 2010, the age-standardized prevalence of hypertension decreased by 2.6% in high-income countries, but increased by 7.7% in low- and middle-income countries [5]. In South Asian nations and other low- and middle-income nations in particular, the rise in hypertension is significant [6]. In 2014, the prevalence of hypertension in South Asian countries were: Bangladesh: 17.9%; Bhutan: 23.9%; India: 31.4%; Maldives: 31.5%; Nepal: 33.8%; Pakistan: 25%; and Sri Lanka: 20.9% [7]. Bangladesh, a low-and middle-income country in South Asia, is no expectation from this rising trend. With the broader range used in 2017, the prevalence of hypertension is 27.5% in the population aged 18 or more, which is far more than in 2014 [8]. According to the latest Bangladesh Demographic and Health Survey (BDHS) 2017-18, about 45% of the women and 34% of the men aged 35 and older have hypertension in Bangladesh. This represents a significant increase over the 2011 projections of 32 and 20 percent, respectively, for women and men in the same age range [9]. Given the substantial increase in incidence of hypertension between surveys, it is important to investigate its patterns and causes in Bangladesh and see whether it is associated with any plausible demographic, socioeconomic, or biological factors.

Sex, age, education, occupation, wealth index, Body Mass Index (BMI), alcohol consumption, diabetes, and cigarette use were all identified as potential risk factors in the national NCDs Risk Factor Survey of Bangladesh conducted in 2010 [10]. Over one in four adults (18 and older) suffer with excessive blood pressure. In general, as people get older and their BMI increases, the prevalence of hypertension increases as well. A national study of NCD risk factors in Bangladesh found that 97 percent of people between the ages of 18 and 69 had at least one risk factor, including high blood pressure, elevated plasma blood glucose, high BMI, use of salt, alcohol consumption, tobacco use, low consumption of fruits and vegetables, and insufficient physical activity [9].

Higher awareness is related to better adherence to antihypertensive medications and BP control, according to research [11]. Low levels of awareness are typical among those living in low-income countries, including Bangladesh [12]. Two-thirds of hypertensive men and half of hypertensive women are unaware that they have high blood pressure. Only 15% of women and 9% of men say they are aware of their health, take their prescribed medications, and have their blood pressure under control [9]. In Bangladesh, hypertension is primarily an under researched public health issue while having a significant illness burden attributed to it and a very high prevalence of unawareness.

The primary goal of this study is to figure out the factors that are associated with the prevalence of hypertension among the adult residents of Dhanmondi in Dhaka city, Bangladesh.

Specific objectives are given below:

- To estimate the prevalence of hypertension
- To identify the factors that are associated with hypertension

2. Methodology

2.1. Data

2.1.1. Study and target population

A study population is a group considered for the purposes of research or statistical analysis. A target population is a group of people with comparable characteristics that are identified as the intended audience for research. Our target population for this project is the entire population of 18 years and above of the Dhanmondi neighborhood in Dhaka, 2022.

2.1.2. Sampling Technique

Simple Random Sampling:

In simple random sampling, every item in the population has an equal chance and probability of being selected. In this instance, the selection of items is fully determined by chance or probability; hence, this sampling strategy is also known as a method of chance. This method is simple to comprehend but difficult to implement in practice.

Sample size determination:

We followed the following formula of a sample size to determine our same size:

$$n = \frac{pqZ^2}{E^2}$$

Where p=0.275

q= 0.725

Z=1.96 at a 5% level of significance and with a margin of error of $\pm$5%,

E=0.05

Here, sample size, $n = \frac{0.275*0.725*1.96^2}{.05^2}$ = 306.3676 = 306 (approximately)

Therefore, we get our sample size n=306.

Working with large sample sizes is difficult, and finding a realistic sampling frame can be difficult at times. However, we don't have the list of the respondents because of the low budget and short amount of time that's why we used purposive sampling. When researchers engage in purposeful sampling, they carefully consider how they will generate a sample population, even if it is not statistically representative of the larger population at hand. As the name suggests, researchers visited this community on purpose because they believe that its members match the demographic profile of the target population. Also, in an attempt to reduce the cost and time of data gathering, a sample size of 206 was considered.

Data collection period:

The time period that we used to collect our data was from the 10th of June to the 20th of July, 2022.

2.2. Variables

2.2.1. Dependent Variable

Hypertension: Blood pressure rises and falls throughout the day. When blood pressure stays elevated over time, it is called high blood pressure. The medical term for high blood pressure is hypertension. Raised or high blood pressure acts as one of the contributing and intermediate risk factors for developing coronary heart disease, stroke, and kidney disease [13]. When the heart beats (systolic), an adult's blood pressure should be 120 mmHg, and when the heart relaxes, it should be 80 mmHg (diastolic). An average systolic blood pressure of over 140 mmHg, an average diastolic blood pressure of over 90 mmHg, a self-reported previous diagnosis of hypertension by a healthcare provider, and/or self-reported current use of antihypertensive medications were all considered to be indicators of hypertension.

2.2.2. Independent Variables

- **Age of the respondent:** Six categories have been created for this variable: 18-24, 25-34, 35-44, 45-54, 55-64, and above 65.
- **Sex of the respondent:** This variable is classified into two groups male and female.
- **Religion of the respondent:** This variable is classified into three groups, Islam and Hinduism, and Others.
- **Education of the respondent:** To identify which educational levels of students have a history of hypertension, this variable is separated into four categories: illiterate, primary education, secondary education, and the remaining higher education groups are labeled as higher.

- **Number of family members under this household:** The number of families is taken into account to determine whether or not there is any evidence of hypertension.
- **Currently working:** This variable is divided into two groups: those who are now employed and those who are not, as indicated by a Yes or No response.
- **Income of the respondent:** This variable is divided into five category groups in a thousand metrics: <5, 5-10, 10-20, 20-50, and >50.
- **Family history of hypertension:** Family members have similar genes, habits, way of life, and circumstances that can affect their health and disease risk. Therefore, this variable is further divided into two categories that show whether or not there is a family history of hypertension. These categories are indicated by a Yes or No response.
- **History of heart disease:** This variable, which also indicates a Yes or No response, is used to determine whether there is a link between people with heart disease and hypertension.
- **Having any major disease:** To determine whether the subjects are affected by any other serious illness, this variable is divided into the two categories Yes and No.
- **Smoking status:** Smoking cigarettes has an immediate hypertensive effect, hence this variable is further separated into two groups, Yes or No, to determine if the respondent smokes or not.
- **Alcohol consumption:** Alcohol consumption can result in severely elevated blood pressure. The Yes or No response will indicate whether or not the person is currently consuming alcohol in this variable.
- **Coffee intake per day:** The variable is divided into three categories: >3, <3, and not consuming. If caffeine is regularly consumed, the response will either be more than three cups (>3) or fewer than three cups (<3); otherwise, the response will be ‘No’.
- **Sleeping hours per day:** This variable is divided into three categories: less than six hours (denoted as "<6"), more than eight hours (denoted as ">8"), and the normal number of sleeping hours per day, which is between six and eight hours (denoted as "6-8").
- **Walking hours per day:** This variable is divided into two categories: less than 30 minutes (<30 minutes) and more than 30 minutes (>30 minutes).

- **Diet schedule:** Hypertension can be lowered with a balanced diet and an appropriate diet program. Diet schedule is a defined variable that is divided into two groups: those who follow a diet schedule and those who don't and is represented by Yes and No indications.
- **Body mass index:** The body mass index (BMI) is a measurement based on a person's mass (weight) and height. The BMI is calculated by dividing the body weight by the square of the height, and it is expressed in kilograms per square meter (kg/m^2) since weight is measured in kilograms and height is measured in meters.
- **Regular check-ups:** This variable, which also indicates a Yes or No response, is used to determine whether the respondent does regular health check-ups or not. If the person does regular health check-ups, it will be marked as "Yes", else "No" will be given in the response.
- **Awareness of Hypertension:** Three categories of respondents have been identified for this variable: those who are aware of hypertension and taking medication, those who are aware but not taking medication, and those who are not.

2.3. Methods

2.3.1. Univariate Analysis

Univariate analysis is a fundamental form of statistical data analysis. Here, the data consists of a single variable and is not concerned with the relationship between cause and effect. Univariate analysis is the simplest method of data analysis. Uni indicates that the data has only one type of variable.

2.3.2. Bivariate Analysis

Bivariate analysis is one of the statistical analyses that involve the observation of two variables. Here, one variable is dependent and the other variable is independent. The definition of bivariate analysis is the examination of any concurrent relationship between two variables or characteristics.

The Pearson's chi-square test is used to assess the independence of the row and column variables without identifying the degree or direction of the association. The purpose of constructing cross tables for two distinct variables is to see whether there is a significant relationship between the variables. The chi-square test compares an observed set of frequencies to a set of frequencies that would be predicted under the H_O distribution. Generally, it is used to investigate statistical independence.

Assumptions:

1. Both variables are categorical.
2. All observations are independent.
3. Cells in the contingency table are mutually exclusive.
4. Expected value of cells should be 5 or greater in at least 80% of cells.

Hypothesis:

H_O: There is no significant association between the two categorical variables.

H_1: There is a significant association between two categorical variables.

Test Statistic:

The test statistic for Chi-Square test is

$$x^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{\left(O_{ij} - E_{ij}\right)^2}{E_{ij}}$$

Where O_{ij} and E_{ij} $(i = 1, 2, \dots, r; \;\; j = 1, 2, \dots, c)$ be the observed and expected frequencies of the *(i,j)* cell corresponding to the ith row and jth column. This distribution has x^2 with $(r-1) \times (c-1)$ degrees of freedom.

Decision Rule:

If the estimated chi-square value is greater than the chi-square critical value, the null hypothesis is rejected. If the estimated chi-square value is less than the chi-square critical value, then the null hypothesis fails to reject.

2.3.3. Logistic Regression Model (Binary Model)

The logistic regression is a special case of generalized linear model (McCullagh and Nelder, 1989), which allows one to forecast a categorical outcome, from a set of variables that may be continuous, discrete outcome or a mix of these. If the outcome is dichotomous (binary) then the model is called a binary logistic regression model. Dichotomous outcome is the most normal situation in biology and epidemiology, standing for the presence or absence of a disease.

Logistic Regression as Generalized Linear Model

Under a binary logistic regression model, the response variable Y has a Bernoulli distribution. Suppose there are n independent outcomes of the response variable Y_i, $i = 1, 2, \dots, n$ with probability of success π_i. Then the variable Y_i has probability mass function of the form

$$f(y_i) = \pi_i^{y_i}\left(1 - \pi_i^{1-y_i}\right); \quad y_i = 0{,}1 \quad \text{and} \quad 0 < \pi_i < 1.$$

Let $x_i = \left(x_{i1}, x_{i2}, \dots, x_{ij}, \dots, x_{ip}\right)'$ be the $p \times 1$ vectors of covariates associated with Y_i and $\beta = (\beta_0, \dots, \beta_j, \dots, \beta_p)'$ be the $(p+1) \times 1$ vector of regression coefficients that are to be estimated. Binary logistic regression model is a member of generalized linear model (GLM) because of the following reasons:

a) The probability distribution function of Y_i , $f(y_i)$ is a member of the exponential family with canonical form, i.e.,

$$f(y_i) = \pi_i^{y_i}\left(1 - \pi_i^{1-y_i}\right)$$
$$= exp\,[\, y_i\, log\, log\, \left(\tfrac{\pi_i}{1-\pi_i}\right) + log\,(1 - \pi_i)].$$

Therefore, Bernoulli distribution belongs to exponential family of distribution with

$$a(y_i) = y_i$$
$$b(\pi_i) = log\,(\frac{\pi_i}{1 - \pi_i})$$
$$c(\pi_i) = log\,(1 - \pi_i)$$
$$d(y_i) = 0.$$

Since, $a(y_i) = y_i$, Bernoulli distribution has a canonical form with natural parameter, $b(\pi_i) = log\,(\frac{\pi_i}{1-\pi_i})$. One can use this natural parameter, $b(\pi_i)$ as a link function, if

1. $b(\pi_i)$ is a function of $\mu_i = E(Y_i)$.
2. $b(\pi_i)$ is a differentiable function of π_i.
3. The range of $b(\pi_i)$ is between $-\infty$ and$+\infty$.

From the properties of exponential family of distribution, one may write,

$$E[a(y_i)] = E(y_i) = -\frac{c'(\pi_i)}{b'(\pi_i)}$$

$$\therefore E(y_i) = \mu_i = \frac{\pi_i(1-\pi_i)}{(1-\pi_i)} = \pi_i$$

Thus $\pi_i = \mu_i$ and therefore the natural parameter $b(\pi_i) = b(\mu_i) = log\ log\ \left(\frac{\mu_i}{1-\mu_i}\right) = g(\mu_i)$, which is a function of μ_i.

Now, $g'(\mu_i) = \frac{\partial}{\partial \mu_i} g(\mu_i) = \frac{1}{\mu_i(1-\mu_i)}$

Hence, $g'(\mu_i) > 0$ for all μ_i $(0 < \mu_i < 1)$ which implies that $g(\mu_i)$ is differentiable. The range of $g(\mu_i) = log\ log\ \left(\frac{\mu_i}{1-\mu_i}\right)$ is $(-\infty, \infty)$, since $0 < \mu_i < 1$.

Therefore, the natural parameter $b(\pi_i) = g(\mu_i) = log\ log\ \left(\frac{\mu_i}{1-\mu_i}\right)$ can be use as link function in GLM.

b) The GLM for binary response can be written as

$$g(\mu_i) = \eta_i = \varkappa_i'\beta$$

$$\Rightarrow log\ log\ \left(\frac{\mu_i}{1-\mu_i}\right) = \varkappa_i'\beta$$

Which is called as a logit model.

The link function permits the mean of response to be related non-linearly with the covariates, i.e.

$$\mu_i = \frac{exp\ (\varkappa_i'\beta)}{1 + exp\ (\varkappa_i'\beta)}$$

This is known as binary logistic regression model.

Estimation of Parameters

Under GLM, the estimation procedure for binary logistic regression model is described below-

Likelihood Function

Let $Y_i(i = 1, 2, \dots, n)$ be a random sample size n from a Bernoulli distribution, where $\beta = (\beta_0, \dots, \beta_j, \dots, \beta_p)'$ be the regression coefficient that are to be estimated. Then likelihood function can be defined as-

$$L(\beta; Y) = \prod_{i=1}^{n} f(y_i)$$

$$= \prod_{i=1}^{n} {\pi_i}^{y_i}(1 - \pi_i)^{1-y_i}$$

Then the log-likelihood function will be-

$$l(\beta; Y) = logL(\beta; Y)$$

$$= log\left[\prod_{i=1}^{n} {\pi_i}^{y_i}(1 - \pi_i)^{1-y_i}\right]$$

$$= \sum_{i=1}^{n} [y_i log\, \pi_i + (1 - y_i) log(1 - \pi_i)]$$

Score Function

The score function, denoted by $U(\beta)$, can be obtained as

$$U(\beta) = \frac{\partial}{\partial \beta} l(\beta; Y)$$

The jth element of score function can be obtained as

$$U_j(\beta) = \frac{\partial}{\partial \beta_j} l(\beta; Y), \qquad j = 0,1,2, \cdots p$$

Here, the j^{th} element of score function for our model is,

$$U_j(\beta) = \frac{\partial}{\partial \beta_j} l(\beta; Y)$$

$$= \sum_{i=1}^{n} \left[\frac{y_i}{\pi_i} \frac{\partial}{\partial \beta_j} \pi_i - \frac{1-y_i}{1-\pi_i} \frac{\partial}{\partial \beta_j} \pi_i \right]$$

$$= \sum_{i=1}^{n} \frac{\partial}{\partial \beta_j} \pi_i \left[\frac{y_i}{\pi_i} - \frac{1-y_i}{1-\pi_i} \right]$$

$$= \sum_{i=1}^{n} \frac{\partial}{\partial \beta_j} \pi_i \left[\frac{y_i - \pi_i}{\pi_i(1-\pi_i)} \right]$$

$$= \sum_{i=1}^{n} \frac{\partial}{\partial \beta_j} \pi_i [Var(Y_i)]^{-1} (y_i - \pi_i)$$

Now,

$$\frac{\partial}{\partial \beta_j} \pi_i = \frac{\partial}{\partial \beta_j} \frac{exp(x_i{}'\beta)}{1 + exp(x_i{}'\beta)}$$

$$= \frac{\partial}{\partial \beta_j} [1 + exp(-x_i{}'\beta)]^{-1}$$

$$= -[1 + exp(-x_i{}'\beta)]^{-2-} exp(-x_i{}'\beta)(-1)x_{ij}$$

$$= x_{ij} \frac{exp(x_i{}'\beta)}{1 + exp(x_i{}'\beta)} \frac{1}{1 + exp(x_i{}'\beta)}$$

$$= x_{ij}\, \pi_i(1-\pi_i)$$

$$= x_{ij}\, Var(Y_i)$$

Therefore, we get the expression of j^{th} element of score function as follows

$$U_j(\beta) = \sum_{i=1}^{n} x_{ij}\, Var(Y_i)\, [Var(Y_i)]^{-1} (y_i - \pi_i)$$

$$= \sum_{i=1}^{n} x_{ij} (y_i - \pi_i)$$

In matrix notation, the score function can be expressed as

$$U(\beta) = X'(Y - \pi)$$

Information Matrix

The information matrix, denoted by $I(\beta)$, is the variance covariance matrix of the score function $U(\beta)$.

$$I(\beta) = Var\ [U(\beta)] = \left[-E\left[\frac{\partial}{\partial\beta_k}U_j(\beta)\right]\right] = [I_{jk}(\beta)]; \qquad j,k = 0,1,2,\cdots,p.$$

The (j,k)th element of information matrix is given by

$$I_{jk}(\beta) = \left[-E\left[\frac{\partial}{\partial\beta_k}U_j(\beta)\right]\right]$$

$$= -E\left[\frac{\partial}{\partial\beta_k}\sum_{i=1}^{n} x_{ij}(Y_i - \pi_i)\right]$$

$$= E\left[\sum_{i=1}^{n} x_{ij}\frac{\partial}{\partial\beta_k}\pi_i\right]$$

$$= E\left[\sum_{i=1}^{n} x_{ij}x_{ik}Var(Y_i)\right]$$

$$= \sum_{i=1}^{n} x_{ij}x_{ik}Var(Y_i)$$

$$= \sum_{i=1}^{n} x_{ij}x_{ik}\ \pi_i(1 - \pi_i)$$

In matrix notation,

$$I(\beta) = X'Var(Y - \pi)X$$

$$= X'WX$$

Where,

$$W = Var(Y) = diag[Var(Y_1),\cdots,Var(Y_n)] = diag[\ \pi_1(1 - \pi_1),\cdots,n(1 - \pi_n)]$$

Hypothesis Testing

Global test

There are three main tests for hypotheses about regression parameters β, the first test is the usual test based on asymptotic normality of the maximum likelihood estimates, called Wald's test.

Wald test

For large sample, $\hat{\beta}$ has a p-variate normal distribution with mean β and variance covariance estimated by $I(\hat{\beta})^{-1}$ .A test of global hypothesis of $H_0: \beta = \beta_0$ is

$$\chi_w^2 = (\hat{\beta} - \beta_0)^T \, I(\hat{\beta}) \, (\hat{\beta} - \beta_0)$$

Which has a large sample chi-square distribution with p degrees of freedom if H_0 is true for large sample.

Likelihood Ratio Test

The second test is the likelihood ratio test of the hypothesis of $H_0: \beta = \beta_0$ and

$$\chi_{LR}^2 = 2\left[LL(\hat{\beta}) - LL(\beta_0)\right]$$

Which has a large sample chi-square distribution with p degrees of freedom under H_0.

Score test

The third test is the score test. It is based on the different scores, $U(\beta) = \left(U_1(\beta), U_2(\beta), \cdots, U_p(\beta)\right)$.For large sample, $U(\beta)$ is asymptotically p-variate normal with mean 0 and covariance $I(\beta)$ the test of $H_0: \beta = \beta_0$ is

$$\chi_{SC}^2 = U(\beta_0)^T \, [I(\beta_0)]^{-1} U(\beta_0)$$

Which has a large sample chi-square distribution with p degrees of freedom under H_0 for large n.

Local Test

Subset of parameter

If one is interested in testing a hypothesis about a subset of the β's. The hypothesis is then $H_0 : \beta_1 = \beta_{10}$, where $\beta = \left(\beta_1{}^T, \beta_2{}^T\right)^T$. Here β_1 is a $q \times 1$ vector of the β's of interest and β_2 is the vector of the remaining $p - q$ β's.

The Wald test statistic

The Wald test of $H_0 : \beta_1 = \beta_{10}$ is based on the maximum partial likelihood estimators of β. Let $\hat{\beta} = \left(\widehat{\beta_1}^T, \widehat{\beta_2}^T\right)^T$ be the maximum partial likelihood estimator of β. Suppose we partition the information matrix $I \; as \; I = (I_{11} \; I_{12} \; I_{21} \; I_{22} \;)$

$$\chi^2_w = \left(\widehat{\beta_1} - \beta_{10}\right)^T \left[I^{11}\left(\hat{\beta}\right)\right]^{-1} \left(\widehat{\beta_1} - \beta_{10}\right)$$

Where I^{11} is the upper $q \times q$ sub matrix of $I^{-1}\left(\hat{\beta}\right)$. Let $\widehat{\beta_2}$ be the maximum likelihood estimate of β_2 based on the log likelihood with the first β's fixed at a value β_{10}.

Likelihood Ratio Test

The likelihood ratio test of the hypothesis $H_0 : \beta_1 = \beta_{10}$ is expressed as

$$\chi^2_{LR} = 2\left\{LL\left(\hat{\beta}\right) - LL\left[\beta_{10}, \widehat{\beta_2}\,(\beta_{10})\right]\right\}$$

Which has a large sample chi-square distribution with q degrees of freedom under H_0.

The Score test

To test $H_0 : \beta_1 = \beta_{10}$ using the score statistic, let $U_1\left[\beta_{10}, \widehat{\beta_2}\,(\beta_{10})\right]$ be the $q \times 1$ vector of scores for β_1

And at the restricted partial the maximum likelihood estimator of β_2. Then

$$\chi^2_{SC} = U_1\left[\beta_{10}, \widehat{\beta_2}\,(\beta_{10})\right]^T \left[I^{11}\left(\beta_{10}, \widehat{\beta_2}\,(\beta_{10})\right)\right] U_1\left[\beta_{10}, \widehat{\beta_2}\,(\beta_{10})\right]$$

Which has a large sample chi-square distribution with q degrees of freedom under H_0.

(Klein & Moeschberger, 2003).

Individual parameter

Wald Statistic

Wald Statistic is for $H_0: \beta = \beta_0$ given below

$$z^2 = \left(\frac{\hat{\beta} - \beta_0}{SE(\hat{\beta})}\right)^2$$

z^2 has (asymptotically) a chi-squared distribution with $df = 1$.

Wald statistic can be used to test 2-sided alternative, while z can be used to test 1-sided as well as 2-sided alternative.

Likelihood Ratio Test Statistic

The likelihood ratio test statistic for $H_0: \beta = \beta_0$ equals

$$\lambda_{LR} = -2(l(\beta_0) - l(\hat{\beta}))$$

Where $l(\hat{\beta}) = log\left(L(\hat{\beta})\right)$ and $l(\beta_0) = log(L(\beta_0))$ are the "maximized log-likelihood function".

Score Test Statistic

The score test statistic equals for $H_0: \beta = \beta_0$

$$\chi^2_{SC} = U(\beta_0)^T\ [I(\beta_0)]^{-1} U(\beta_0)$$

Which has a large sample chi-square distribution with p degrees of freedom under $H_0: \beta = \beta_0$.

3. Result

3.1. Univariate Analysis

A total of 206 adults aged 18 and above were considered in our study. Among them, 68% were male and 32% were female.

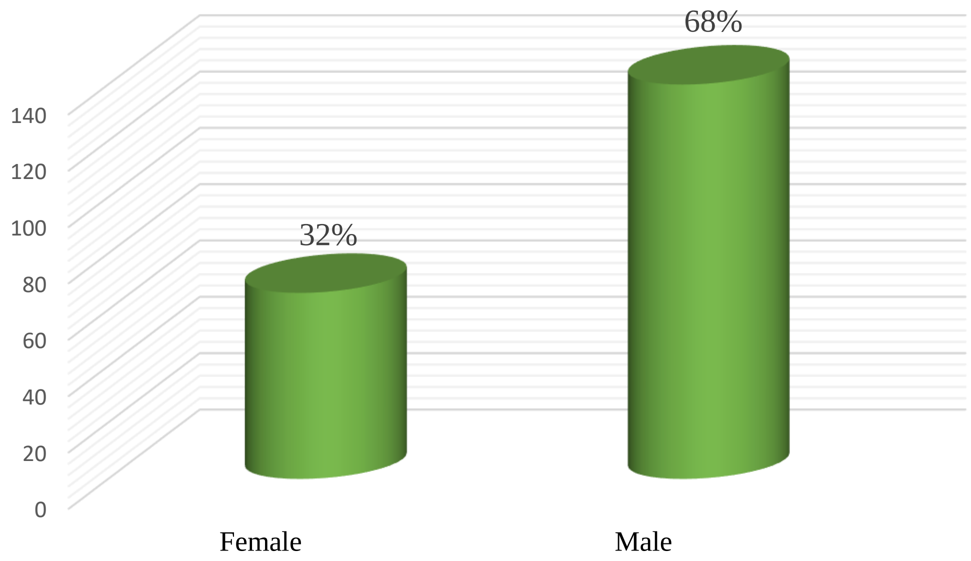

Figure 3.1: Percentages of male and female respondents.

The prevalence of hypertension in Dhanmondi area was 38.3%.

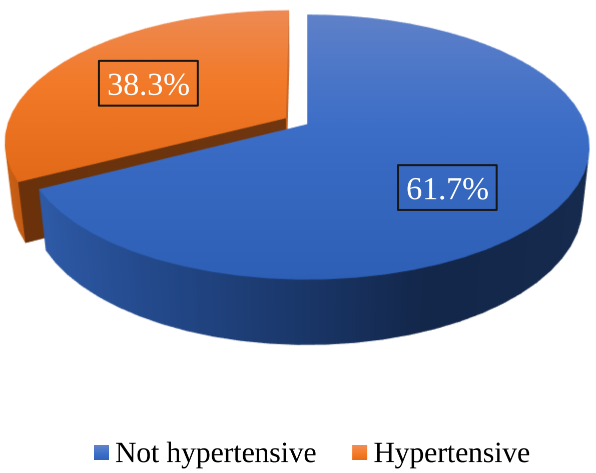

Figure 3.2: A pie chart showing the prevalence of hypertension.

Approximately 18 to 29 years aged respondents were 33% and the highest number of the respondents belong to the 30 to 44 age group.

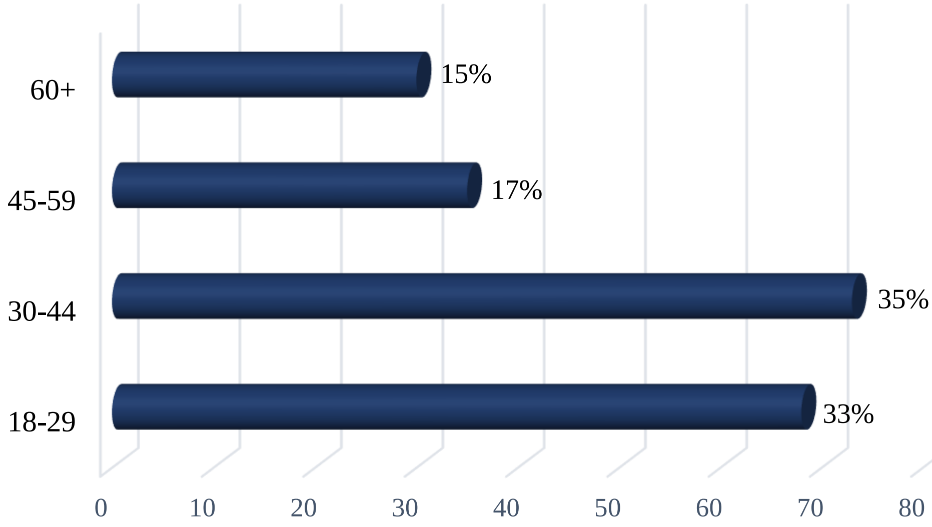

Figure 3.3: Age distribution of the respondents.

Where 55% of the people who answered are single, while 40% are married and 5% are divorced or widowed.

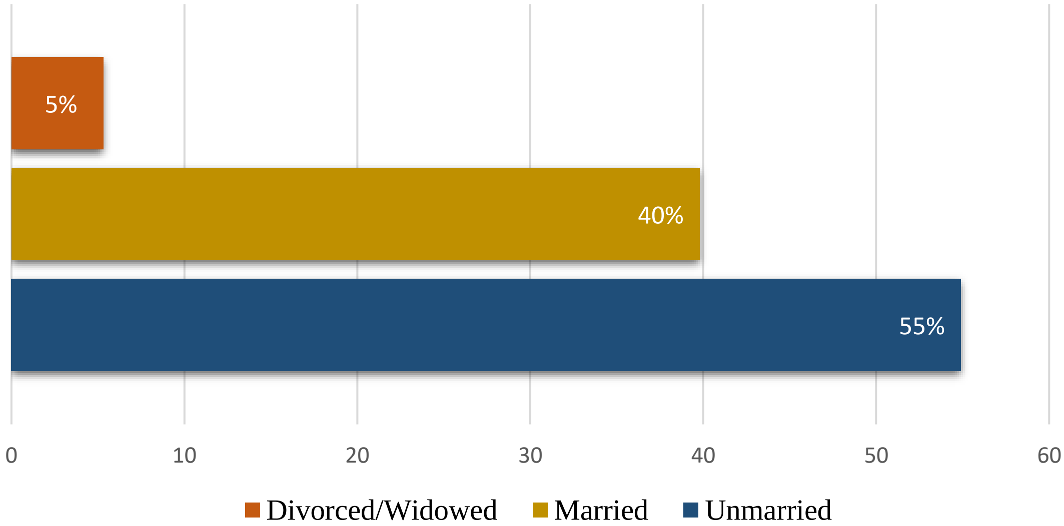

Figure 3.4: A bar chart showing the marital status of the respondents.

About 67% of the people had a higher education, while only 2.9% were not educated.

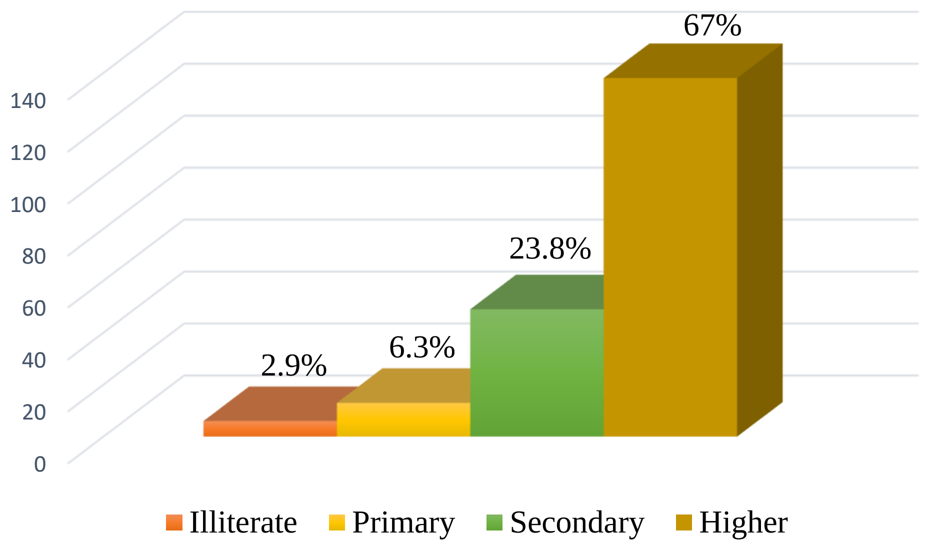

Figure 3.5: Educational attainment of the respondents.

Approximately half of the respondents have an income of more than 20 thousand Taka, and of those, approximately 21% earn less than 5 thousand. That is, almost one-fourth of them had the least income.

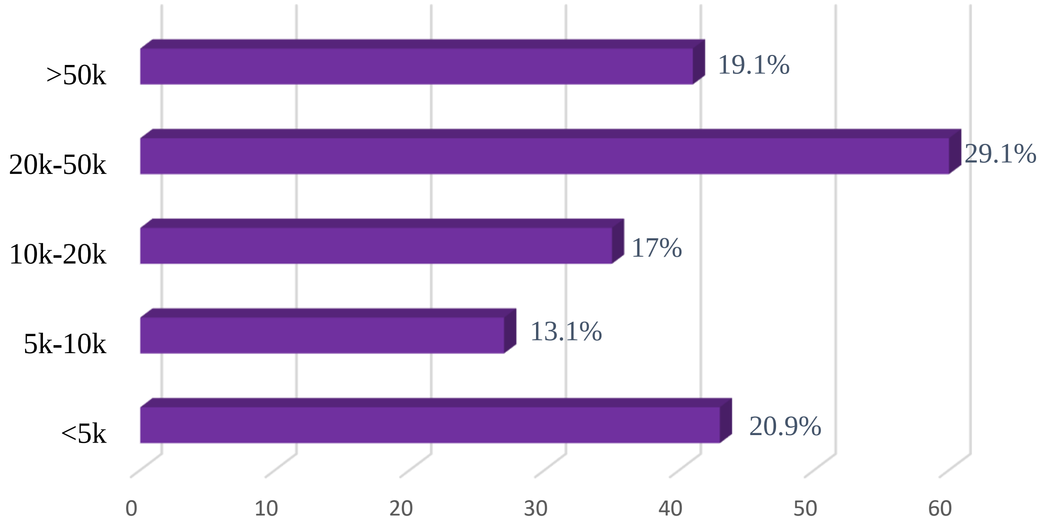

Figure 3.6: Income distribution of the respondents.

This had occurred may be because 35% of the respondents were not working at that time, 65% were working during the survey.

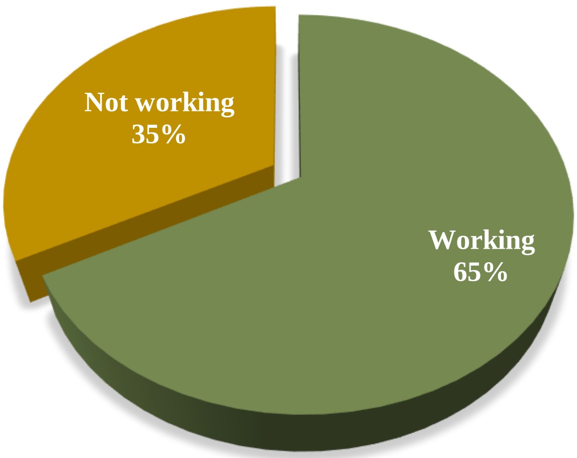

Figure 3.7: Working status of the respondents.

The condition of houses was similar as the percentages of rented houses and owned houses of the respondents were almost equal.

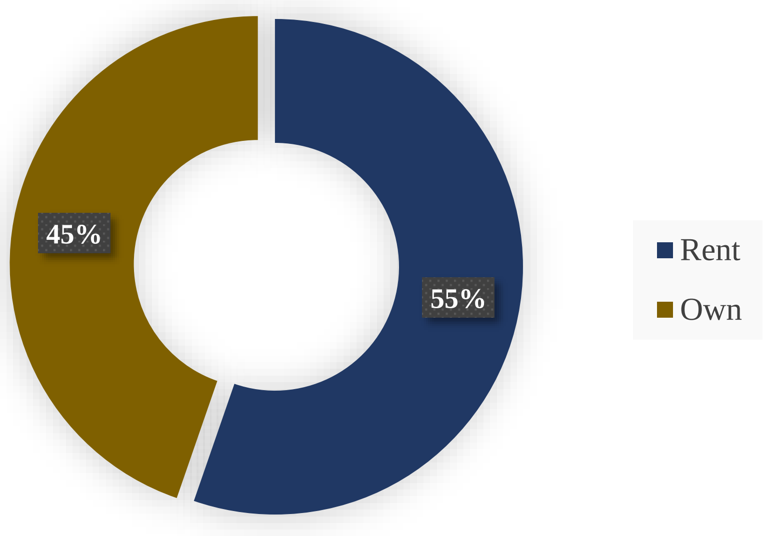

Figure 3.8: Condition of the house of the respondents.

Here, we can see that only 14% of the respondents had heart disease.

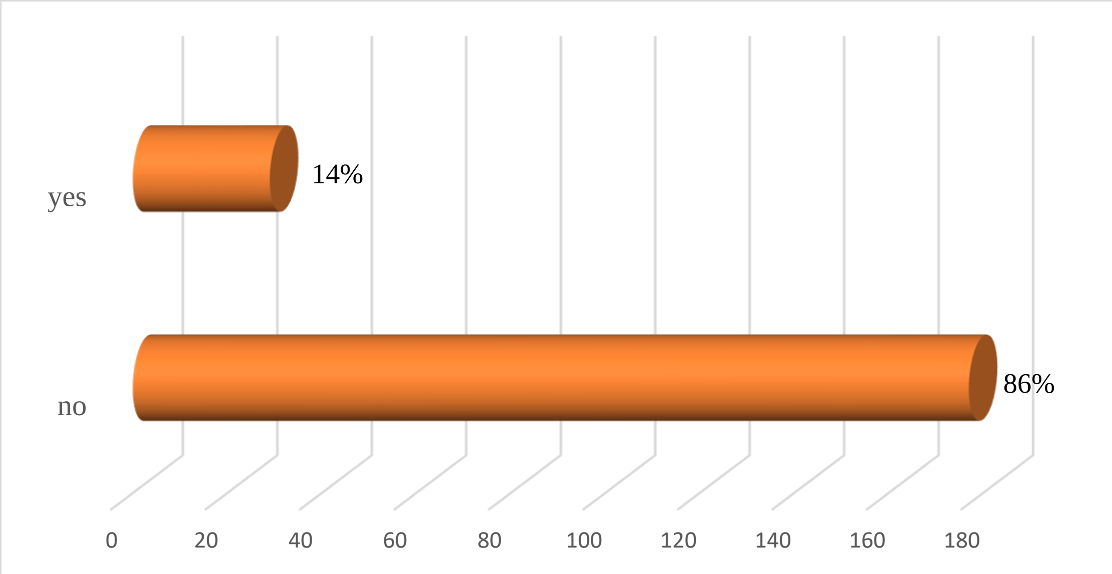

Figure 3.9: A bar chart showing the respondents' heart disease status.

The table shows that approximately 58% of respondents did not smoke cigarettes, whereas 42% were heavy smokers.

	Frequency	Percentage
Non- Smoker	119	58
Smoker	87	42
Total	206	100

Table: Smoking (cigarettes) status of the respondents.

Though a huge number of respondents were smokers, only 16% were alcoholic. There were 84% of the respondents who didn't consume alcohol.

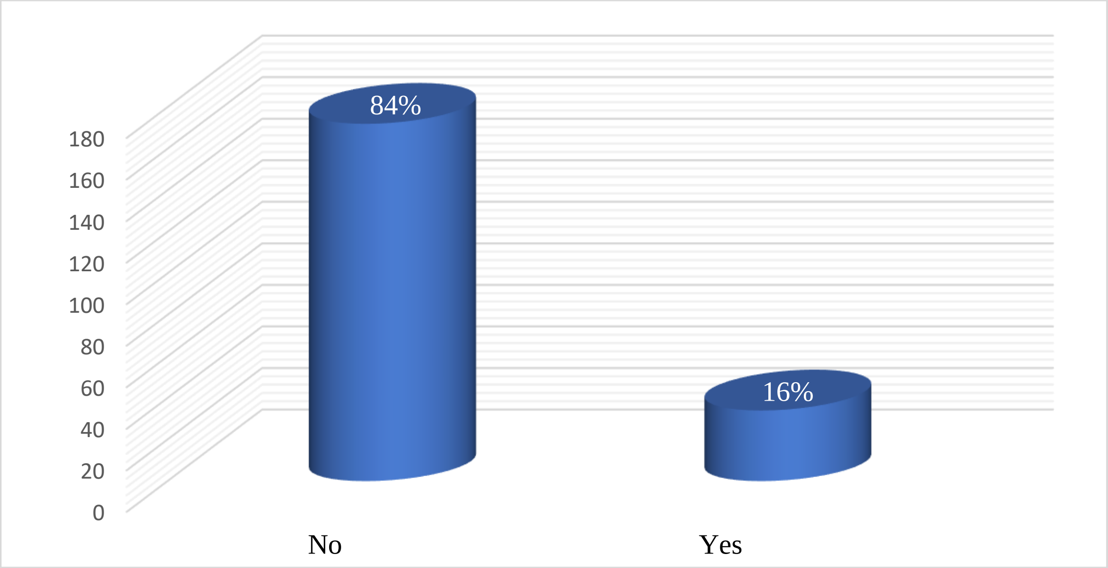

Figure 3.10: Alcohol consumption of the respondents.

About half of the respondents took less than or equals to 3 cups of coffee per day, where almost one-third didn't take coffee at all. Also, a few percentages (14%) took more than 3 cups of coffee in a day.

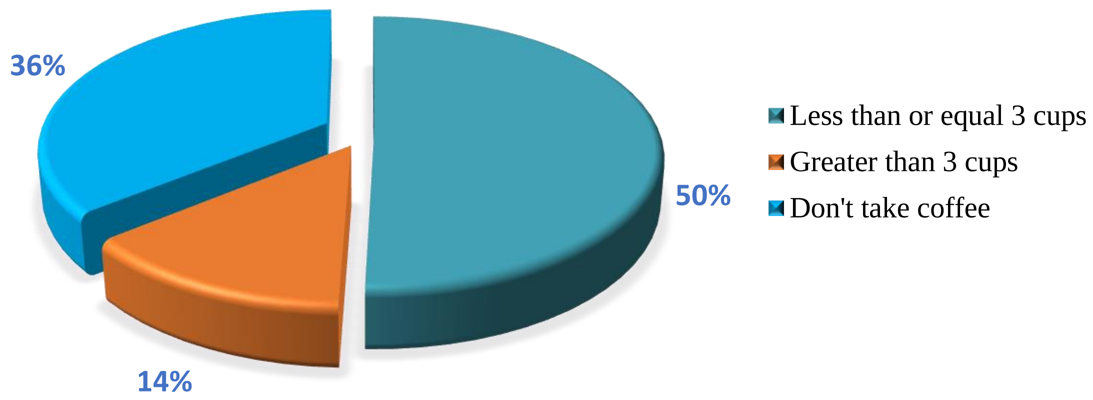

Figure 3.11: Coffee consumption (per day) status of the respondents.

65% of the respondents had the habit of sleeping more than 6 hours and the rest 35% slept less than or equal to 6 hours.

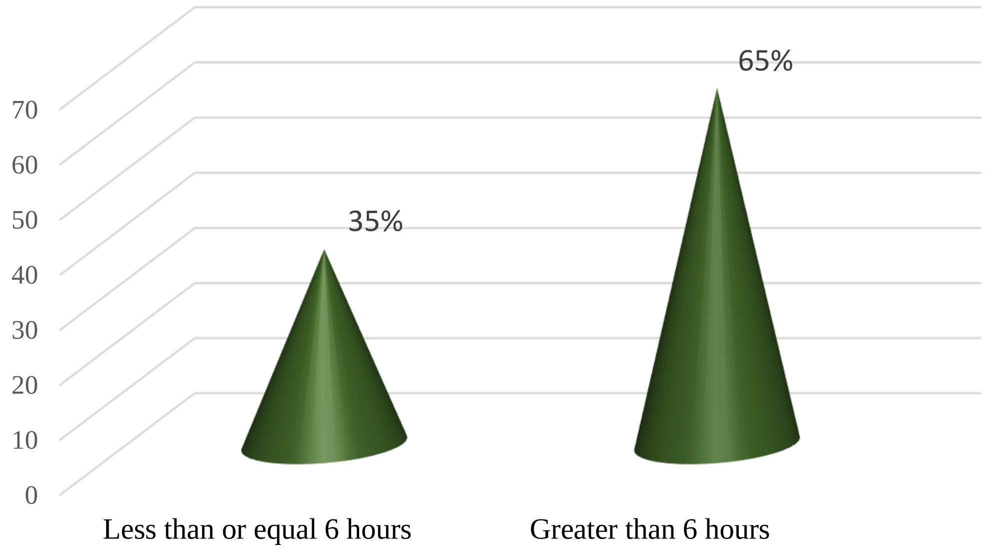

Figure 3.12: Sleeping hours (per day) of the respondents.

Most of the respondents (71%) didn't follow a diet schedule. Only 29% had the habit of maintaining a diet schedule.

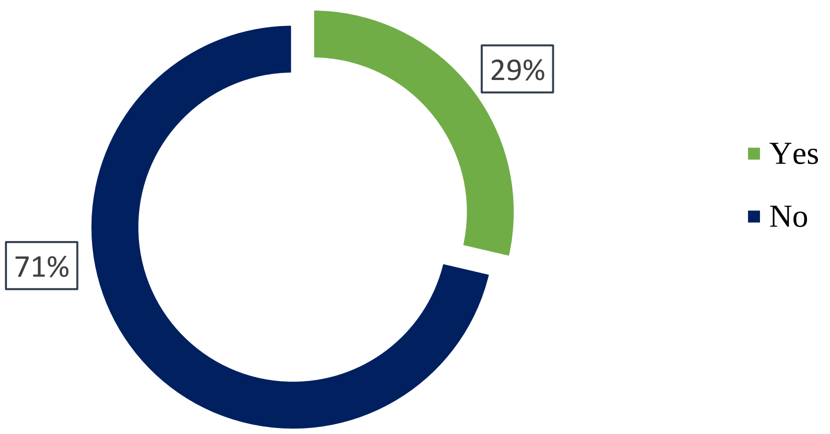

Figure 3.13: Maintaining a diet schedule by the respondents.

The majority of them (over 50%) take daily walks of at least 30 minutes or more. In addition, more than 40% of people who participated typically walked for less than 30 minutes.

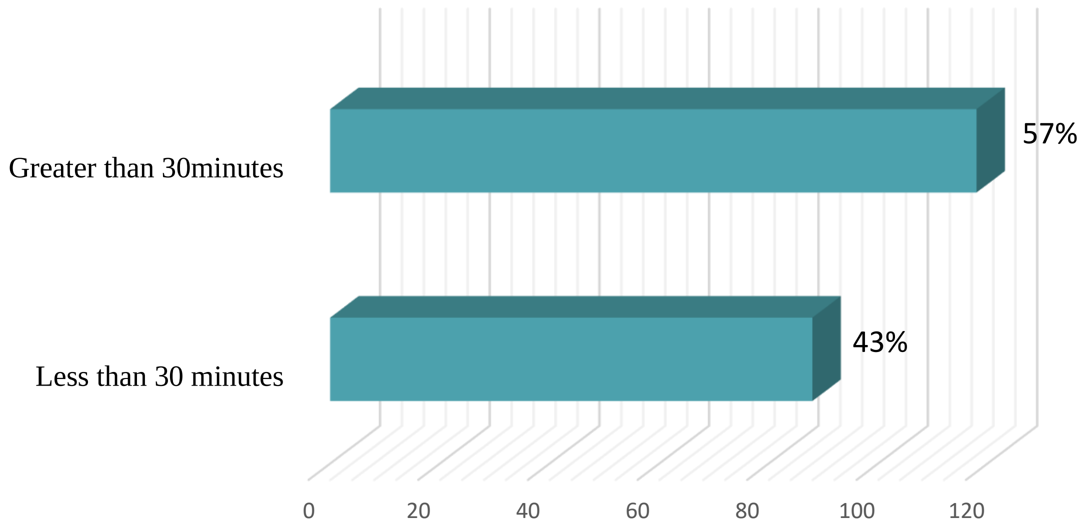

Figure 3.14: Hours of walking (per day) of the respondents.

We had 57% of respondents with healthy status, which is 8 times higher than the obese. About 36% of the respondents were overweight.

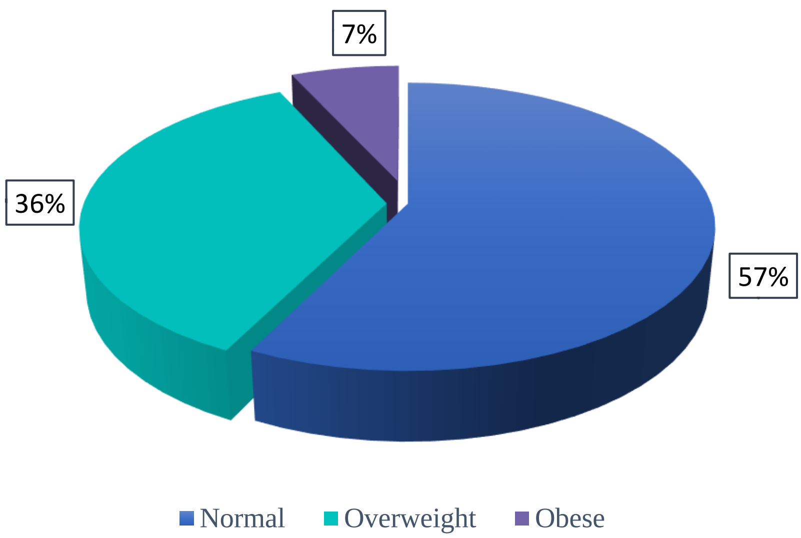

Figure 3.15: Body Mass Index (BMI) of the respondents.

Nearly half of those who answered the survey reported a history of hypertension in their families, which is on par with the percentage of people who said they had no such history.

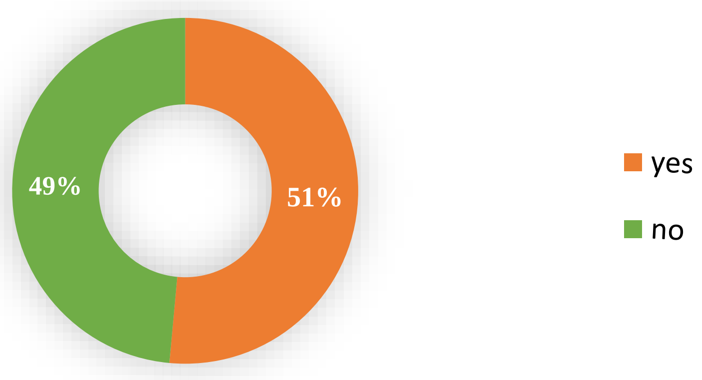

Figure 3.16: Having a family history of hypertension among the respondents.

3.2. Bivariate Analysis

A chi-square test has been conducted to determine the association of a specific explanatory variable with hypertension. We have found that all the explanatory variables except gender, smoking status, alcohol consumption, walking hours, diet schedule, and sleeping hours had significant association with hypertension at a 5% level of significance.

The prevalence of hypertension was highest among the males and it was more than twice (67.1%) among the males compared to the females (32.9%).

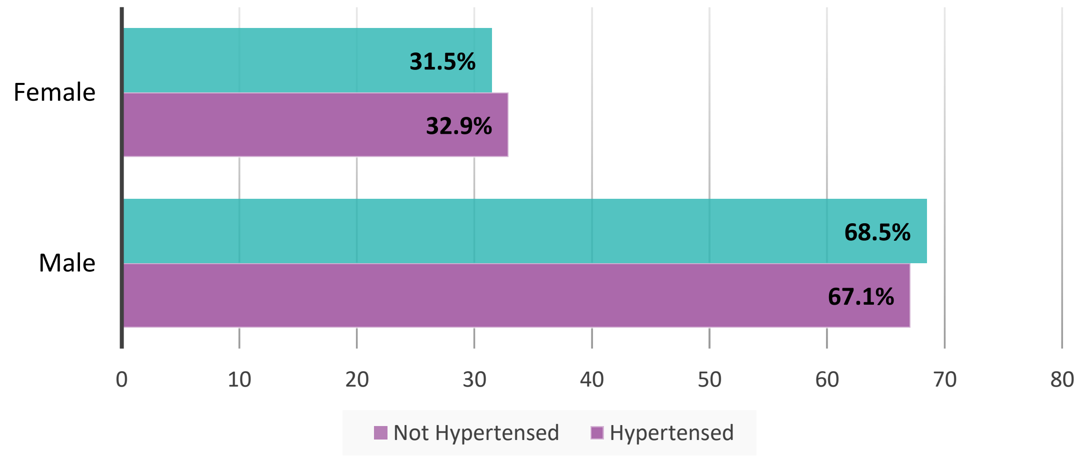

Figure 3.17: Prevalence of hypertension by gender.

With the increase of age, the prevalence of hypertension increased significantly (*p*-value <0.01). The highest prevalence of hypertension was observed among those aged 65 and older, whereas the lowest prevalence was found among those aged 18 to 29 years.

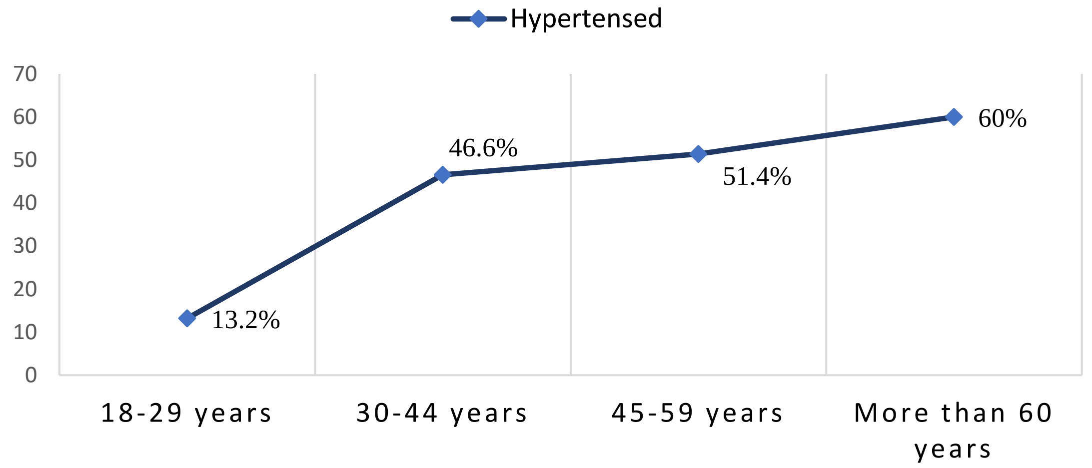

Figure 3.18: Association of age with the prevalence of hypertension.

The prevalence of hypertension was highest among those who were divorced/widowed (55%), followed by those who had never married (51%) and then those who were married (18%). That is, women who were married have a lower rate of hypertension.

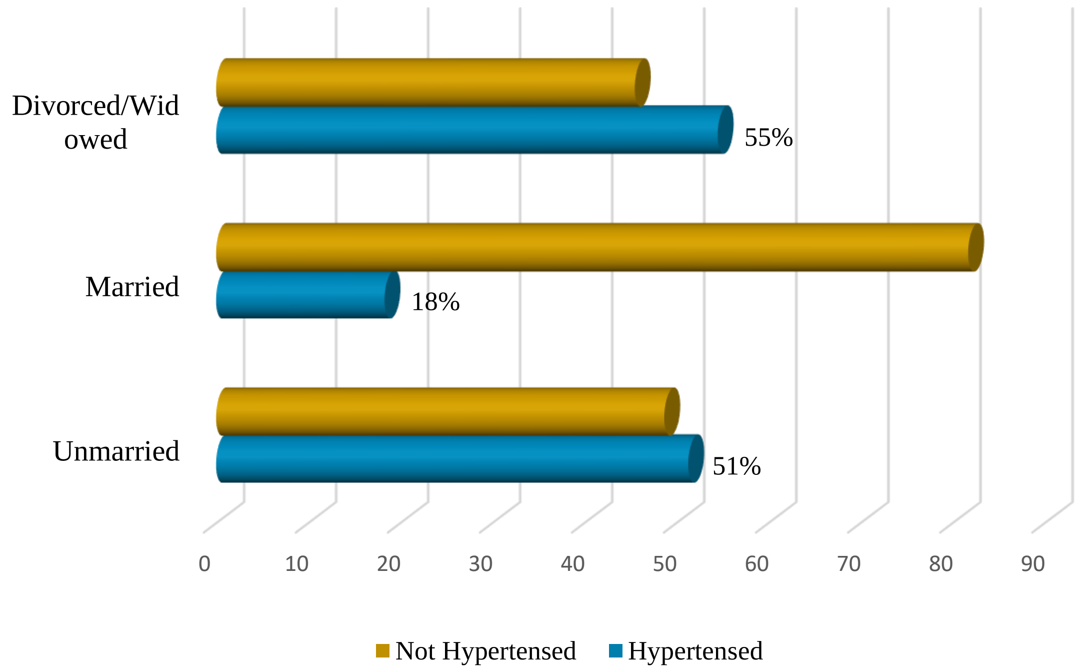

Figure 3.19: Relationship between hypertension and marital status.

The prevalence of hypertension was lowest among illiterate people (16.7%) and this figure is almost equal to the figure of secondary education (16.3%). Primary and higher educated people had a higher proportion of hypertension (46.2% and 46.4% respectively).

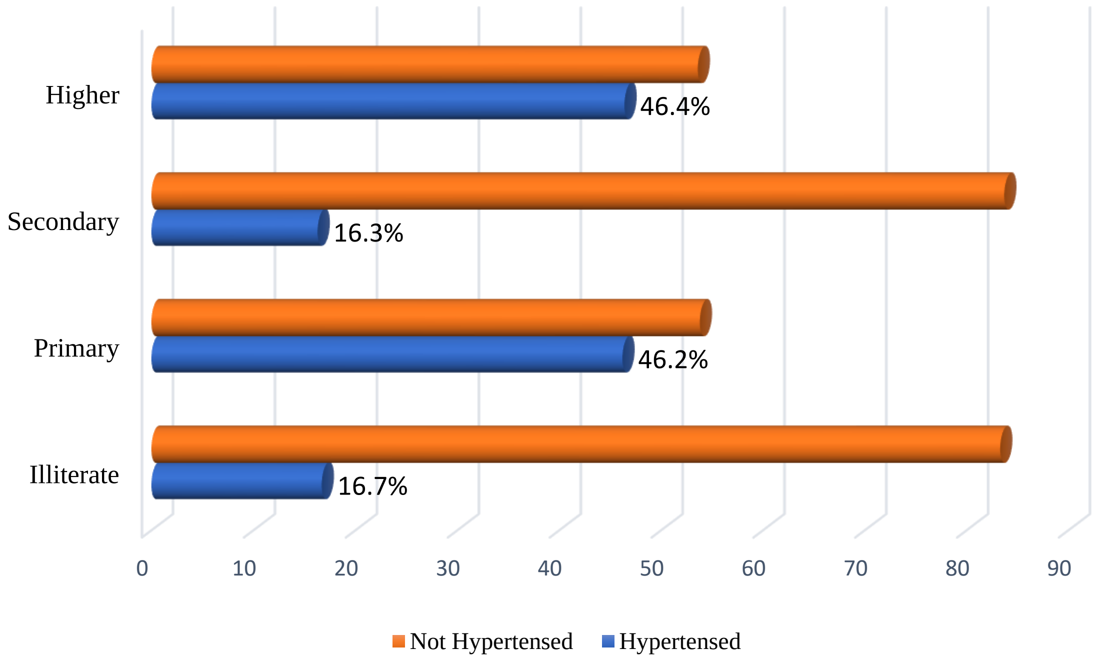

Figure 3.20: Associating educational attainment with the prevalence of hypertension.

We have found a positive association between income and hypertension. Hypertension showed a gradually increasing pattern with the increase of income. People having earnings higher than 50,000 taka found to have the highest prevalence, which was 56%.

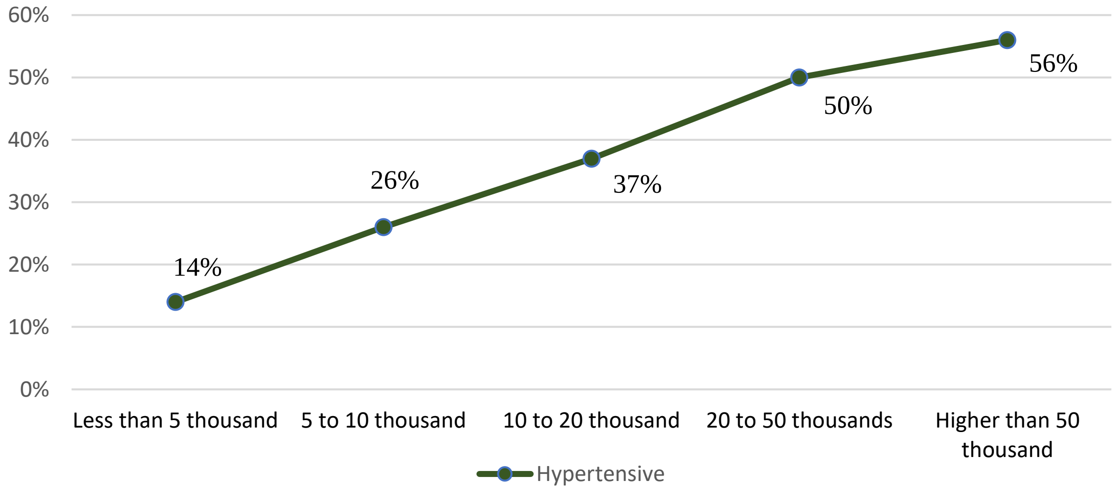

Figure 3.21: The impact of income on the prevalence of hypertension.

It was observed that the rate of hypertension was 43% among the working people, whereas it was 29% among the non-working people.

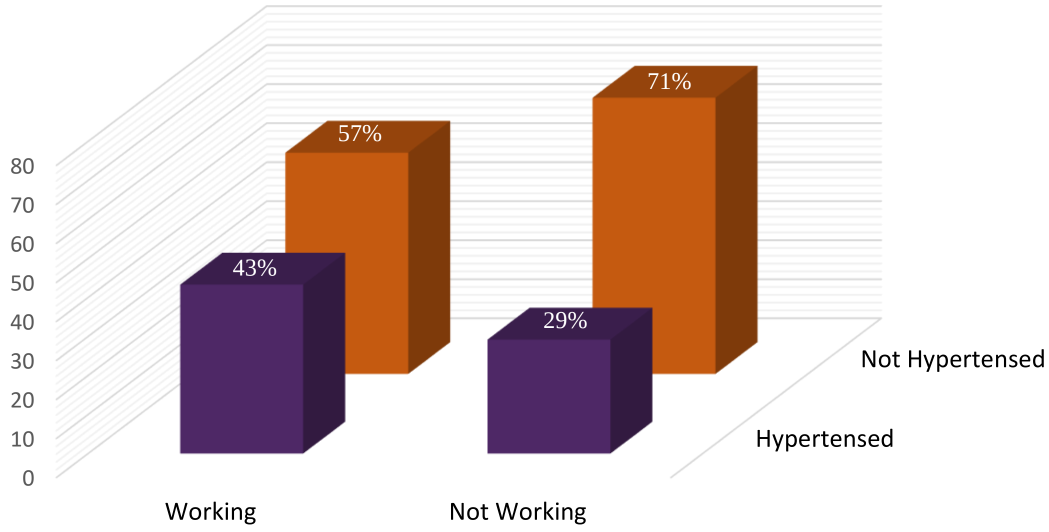

Figure 3.22: Hypertension with the working status of the respondents.

The percentages of hypertension were higher among the people who have their own house (50%) compared to people who live in the rented house (29%).

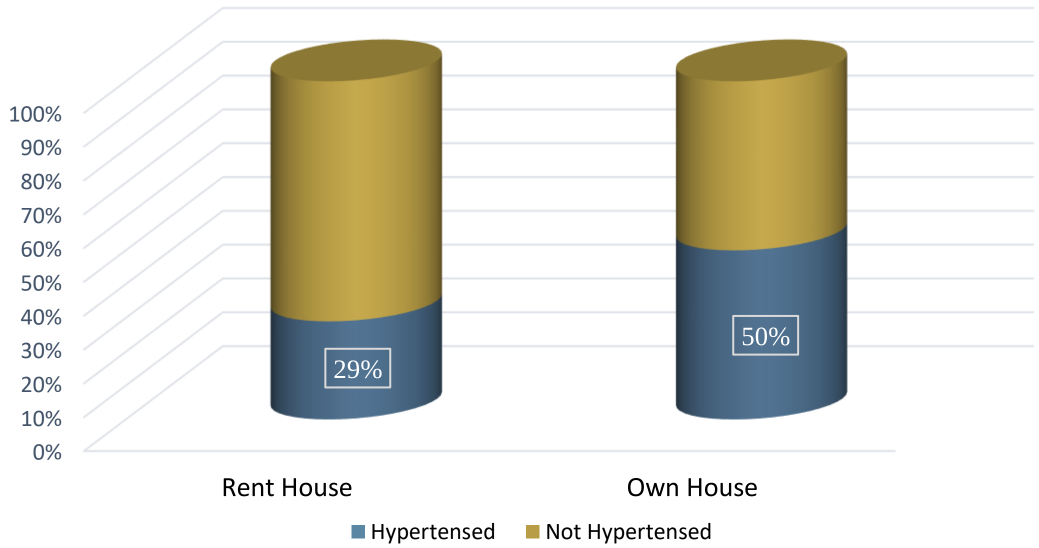

Figure 3.23: Housing conditions of respondents with hypertension.

Hypertension was highest (61%) among the people who took more than three cups of coffee per day and was lowest (29%) among the people who took 1 to 3 cups of coffee per day.

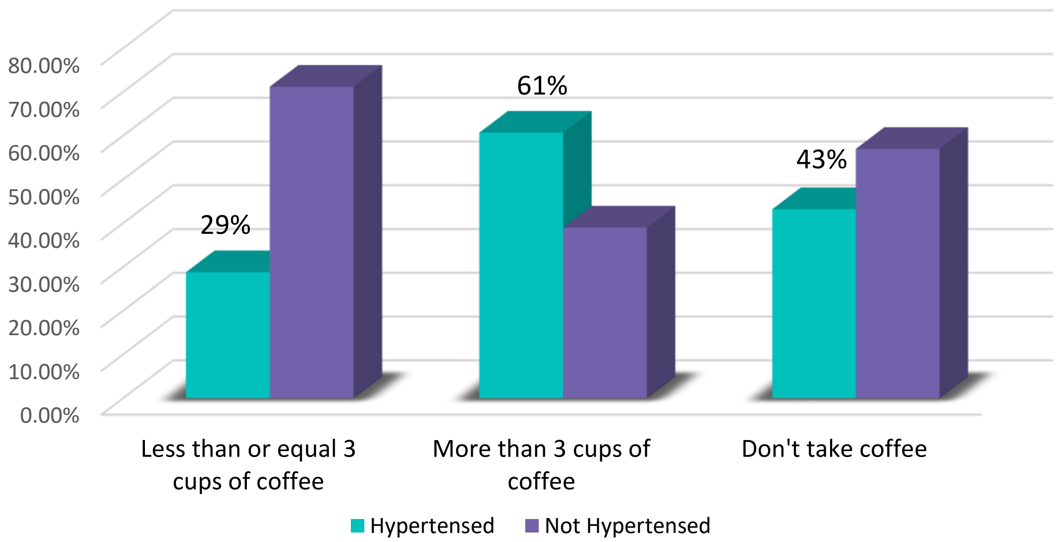

Figure 3.24: Coffee intake per day with hypertension.

The prevalence of hypertension was slightly higher among the smokers (40.2%) compared to the non-smokers (37%).

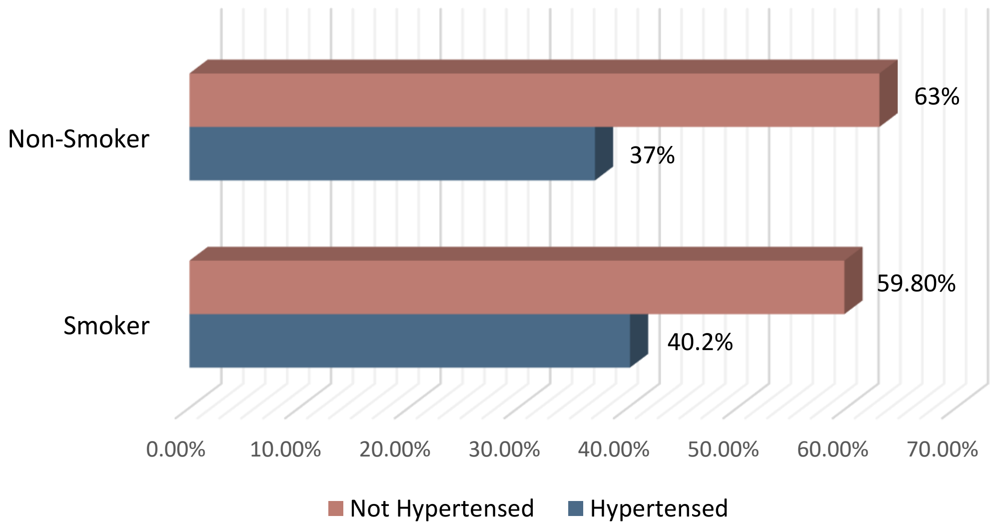

Figure 3.25: Association of smoking with prevalence of hypertension.

It was observed that the rate of prevalence was 44% among the alcoholic people whereas it was 37.2% among the people who didn't drink alcohol.

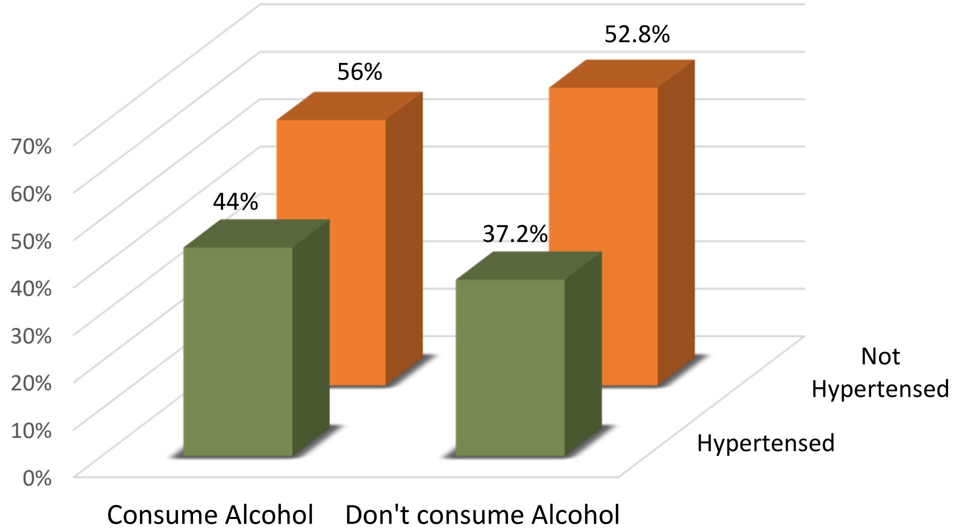

Figure 3.26: Prevalence of hypertension with alcohol consumption.

We have found higher prevalence of hypertension among the people who walked

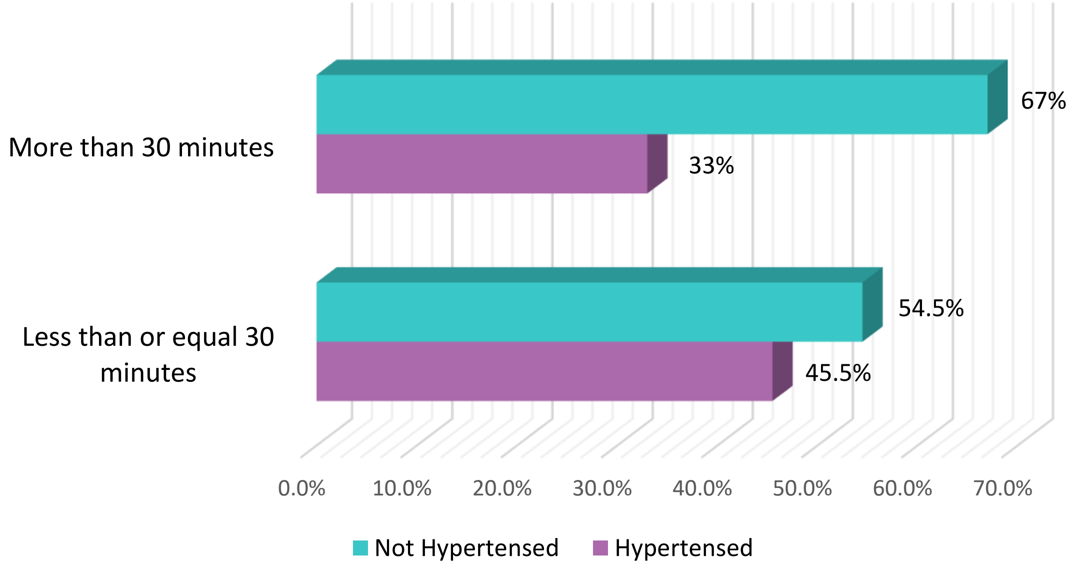

Figure 3.27: Walking hours per day with hypertension.

less than 30 minutes (45.5%) daily compared to the people who walked more than 30 minutes (33%). 42.2% prevalence of hypertension was observed among those who didn't follow a diet schedule whereas it was 29% among those who followed a diet schedule.

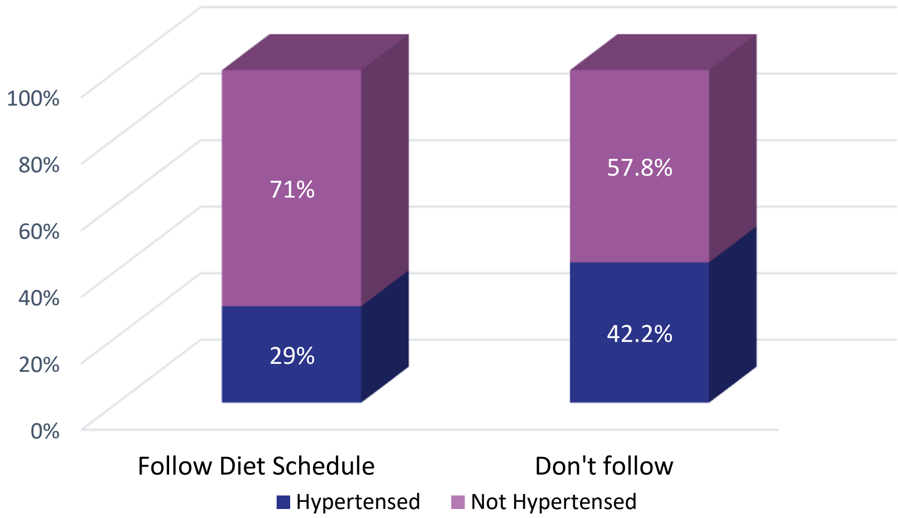

Figure 3.28: Influence of following a diet schedule on prevalence of hypertension.

Among the people who sleeps 1 to 6 hours daily, 45.2% were hypertensive whereas it was 34.6% among the people who sleeps more than 6 hours.

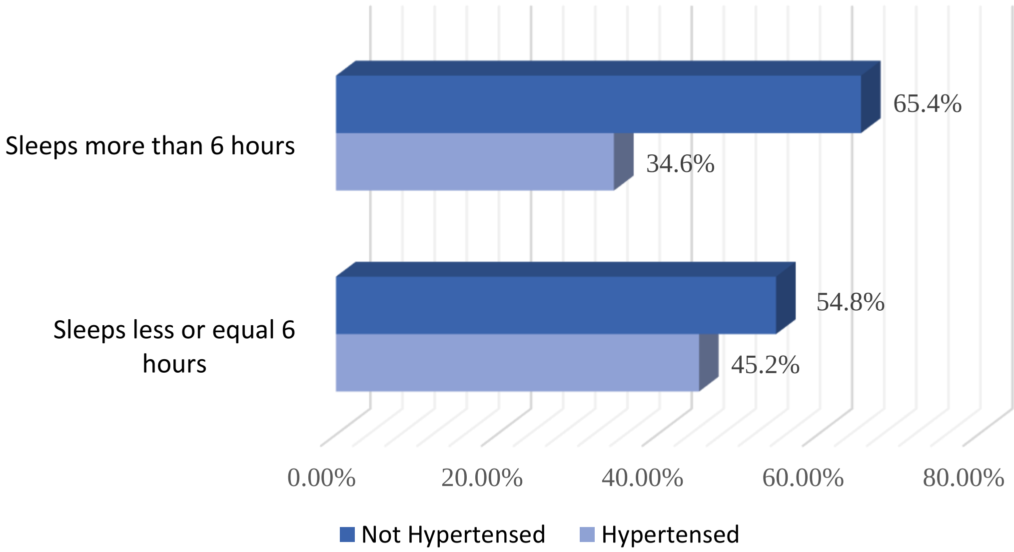

Figure 3.29: Sleeping hours with prevalence of hypertension.

As expected, the prevalence hypertension was around twice (53%) among the overweight/obese people compared to healthy people (27%).

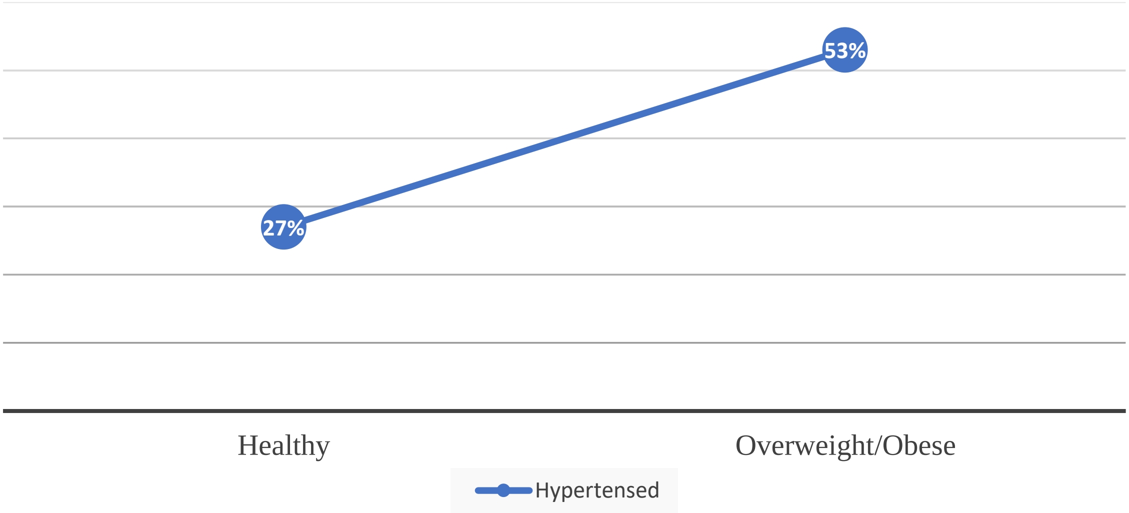

Figure 3.30: Impact of Body Mass Index on hypertension.

There exists a positive association between hypertension status and family history of hypertension. Respondents who came from a family with a history of hypertension had more than twice (54%) the hypertension as those who did not come from a family with a history of hypertension (22%).

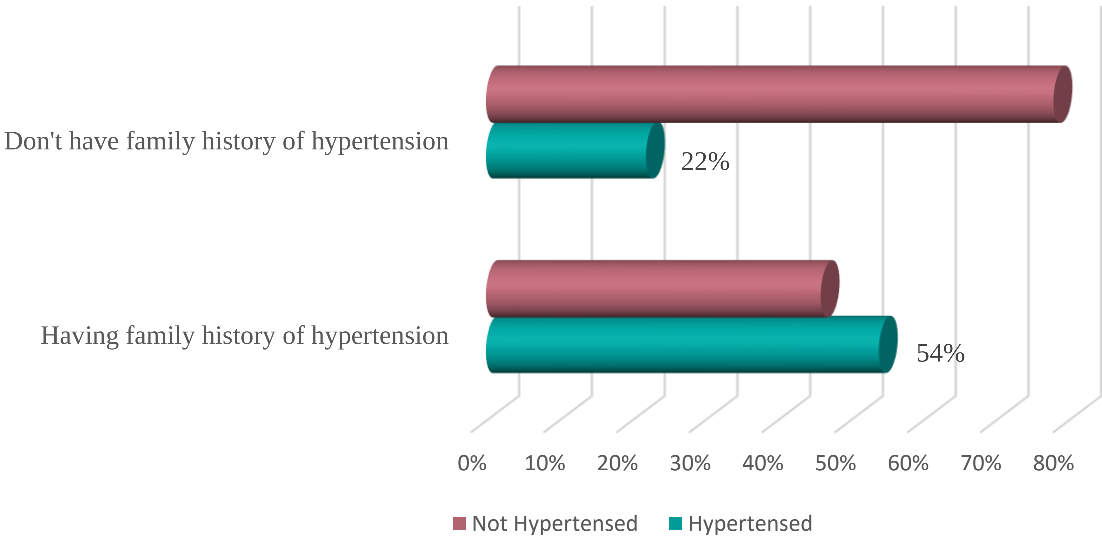

Figure 3.31: Relationship between hypertension prevalence and family history of hypertension.

As usual, the prevalence of hypertension was more than twice (69%) among the people who had heart disease compared to the people who didn't have heart disease (33.3%).

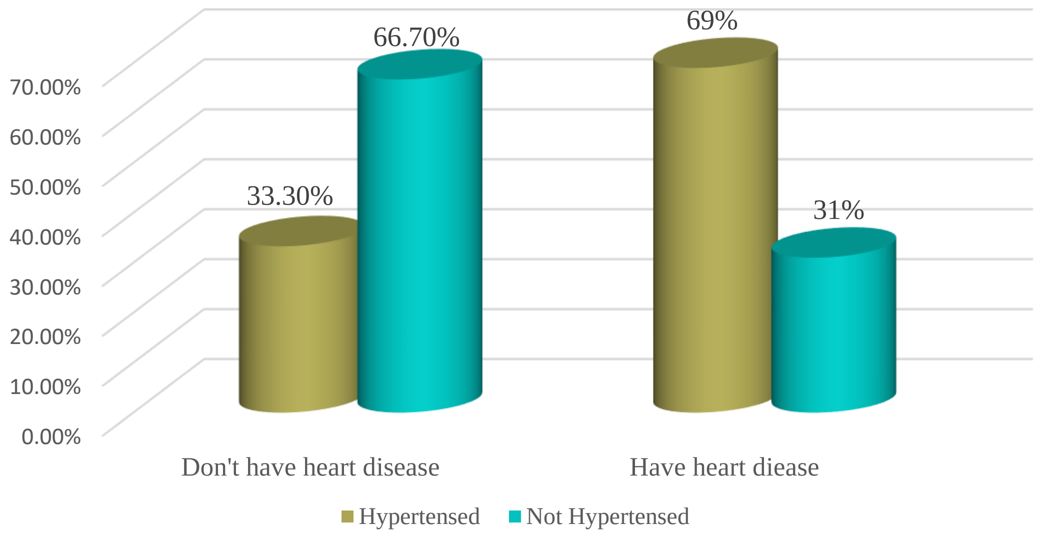

Figure 3.32: Impact of heart disease on hypertension.

3.3. Logistic Regression Model

All the covariates that are significantly associated with hypertension status in the bivariate analysis are considered in multivariate analysis. To examine the adjusted effects of explanatory variables on hypertension we have employed a binary logistic regression model, the outputs are reported in the following table.

Table: Adjusted odds ratios (AORs) for being hypertensive by explanatory variables.

Explanatory Variables	Odds Ratio	95% Confidence Interval	*p*-value
Age			
18-29 (ref)			
30-44	4.428	(1.246, 15.728)	0.021*
45-59	5.476	(1.169, 25.658)	0.031*
60+	4.563	(0.827, 25.169)	0.081
Marital Status			
Unmarried (ref)			
Married	0.72	(0.257, 2.014)	0.532
Divorced/Widowed	1.554	(0.282, 8.572)	0.613

Explanatory Variables	Odds Ratio	95% Confidence Interval	*p*-value
Education			
Illiterate (ref)			
Primary	7.757	(0.321, 187.399)	0.207
Secondary	1.128	(0.062, 20.517)	0.935
Higher	2.805	(0.162, 48.484)	0.478
Income			
<5K (ref)			
5K-10K	2.214	(0.446, 10.994)	0.331
10K-20K	3.587	(0.782, 16.45)	0.1
20K-50K	5.043	(1.146, 22.196)	0.032*
>50K	3.105	(0.642, 15.009)	0.159
Current Working Status			
Do not working (ref)			
Working	0.63	(0.223, 1.779)	0.383
Coffee (per day)			
Less than or equal 3 cups (ref)			
More than 3 cups	3.458	(1.074, 11.138)	0.038*
Don't take coffee	0.789	(0.335, 1.859)	0.588
Family History of Hypertension			
No (ref)			
Yes	4.05	(1.819, 9.018)	0.001**
Housing Condition			
Rented house (ref)			
Own House	1.433	(0.632, 3.253)	0.389
Heart Disease			
No (ref)			
Yes	0.315	(0.105, 0.947)	0.04*
Body Mass Index			
Healthy (ref)			
Overweight/Obese	1.43	(0.668, 3.06)	0.357
Constant	0.033		0.03

*Significant codes: * p<0.05, ** p<0.01; K means Thousand taka*

Among the explanatory variables, we have found that age, income, coffee intake (per day), family history of hypertension and heart disease have significant effects on hypertension in the binary logistic regression model. The people aged 30-44 years were

4.428 times as likely to have hypertension whereas the people aged 45-59 years were 5.476 times as likely to have hypertension compared to the people aged 18-29 years. The people with a monthly income between 20,000 and 50,000 TK were 5.043 times as likely to develop hypertension than the people who earned less than 5,000 TK. Among the people who drank more than 3 cups of coffee in a day were 3.458 times as likely to have hypertensive than the people who drank less than three cups of coffee per day. The people who have family history of hypertension had 305% higher odds of having hypertension than the people who have no family history of hypertension. The people who have heart disease had 69.5% lower odds of having hypertension than those who did not have heart disease.

4. Discussion & Limitation

4.1. Discussion

The study was conducted to evaluate the prevalence of hypertension among adults age 18 and over as well as to assess the influence of demographic, socio-economic and biological variables on hypertension. Based on many other studies, the current study was developed to determine how the aforementioned factors may affect hypertension among the residents of Dhanmondi area of Dhaka, Bangladesh. We have interviewed a sample of size 206.

In our study, we observed that age, income, coffee intake, family history of hypertension and heart disease played an important role in the prevalence of hypertension. These factors had a significant influence on hypertension in the adjusted logistic regression model.

This study found that 38.3% of the respondents had hypertension at the time of the survey. This figure is higher than the national hypertension prevalence rate of 28.4% (NIRPORT,2020) and STEPS Survey conducted by who in Bangladesh is 25.2% in 2018[14].

Our study showed that people aged 30-44 and 44-59 were more likely to have hypertension in comparison to people aged 18-29. Similar findings were observed in previous studies [15,16,17].

Income of the respondents between 20 thousand and 50 thousand had a significant positive association with hypertension. The individual wealth index includes individual income as a component. In a study that was quite similar to this one, which was conducted in Sub-Saharan Africa, the researchers found that there was a substantial variation in the prevalence of uncontrolled hypertension according to the individual wealth status of the participants [18].

According to the results of our study, daily coffee consumption of more than three cups was highly associated with hypertension. According to a study, those who consumed more than three cups per day compared to those who consumed less than three cups had a statistically significant rise in hypertension. [19].

Hypertension and a family history of the condition were positively correlated. A study conducted in Japan found that the risk of developing hypertension was 1.5 times higher in people with a history of hypertension in the mother, 1.8 times higher in people with a history of hypertension in the father, and 2.4 times higher in people with a history of hypertension in both parents compared to people whose parents did not have the condition [20].

Our study showed the evidence that the people who had heart disease were less likely to have hypertension than people who didn’t have heart disease. Another study found that both hypertension and borderline isolated systolic hypertension were associated with significantly higher risks of incident cardiovascular disease, stroke, and cardiovascular death, as well as all-cause mortality [21]. The reason for decreased hypertension to cardiovascular events among adults is not completely understood. Maybe they are following doctor's consultation and taking medicine regularly, that's why they are less likely to have hypertension than those who did not have heart disease.

4.2. Limitations

The Simple Random Sampling (SRS) method requires a list of samples before it can be used, however we don't have the list because of the low budget and short amount of time. We only received 206 samples, which is a very tiny number. So, we were unable to apply the SRS approach. When we asked to provide their blood pressure again, the respondents expressed discomfort. The respondents were not comfortable providing their blood pressure on a recurrence as well as when they were in resting state. We could only take the first blood pressure reading because of this.

5. Conclusion

A significant public health concern for Bangladesh is the sudden increase in the prevalence of hypertension. Without addressing serious NCDs like hypertension, it will be impossible to achieve the health-related Sustainable Development Goals by 2030. Based on the results of this study, it is obvious that residents of Dhanmondi, Bangladesh, who were older, had higher amount of income per month, took excessive caffeine, had family history of hypertension and heart disease are expected to contribute to the rising trend of hypertension in Bangladeshi adults. The policymakers should encourage people to reduce coffee intake and increase physical activity.

References

1. WHO, A global brief on Hypertension; World Health Day- 2013, World Heal Organ, 2013;:1-40.
2. *Hypertension*. (2021, August 25). Hypertension. Retrieved October 25, 2022, from https://www.who.int/news-room/fact-sheets/detail/hypertension
3. Khan, R. J., Stewart, C. P., Christian, P., Schulze, K. J., Wu, L., LeClerq, S. C., Khatry, S. K., & West, K. P. (2013, January 21). A cross-sectional study of the prevalence and risk factors for hypertension in rural Nepali women. *BMC Public Health*, *13*(1). https://doi.org/10.1186/1471-2458-13-55
4. Ana, E., Chamidah, N., Andriani, P., & Lestari, B. (2019, December 1). Modeling of hypertension risk factors using local linear of additive nonparametric logistic regression. *Journal of Physics: Conference Series*, *1397*(1), 012067. https://doi.org/10.1088/1742-6596/1397/1/012067
5. Mills, K. T., Bundy, J. D., Kelly, T. N., Reed, J. E., Kearney, P. M., Reynolds, K., Chen, J., & He, J. (2016, August 9). Global Disparities of Hypertension Prevalence and Control. *Circulation*, *134*(6), 441–450. https://doi.org/10.1161/circulationaha.115.018912
6. Shabuz, Z. R., Haque, M. E., Islam, M. K., & Bari, W. (2022, May 14). Link between unmet need and economic status in Bangladesh: gap in urban and rural areas. *BMC Women's Health*, *22*(1). https://doi.org/10.1186/s12905-022-01752-8
7. Neupane, D., McLachlan, C. S., Sharma, R., Gyawali, B., Khanal, V., Mishra, S. R., Christensen, B., & Kallestrup, P. (2014, September). Prevalence of Hypertension in Member Countries of South Asian Association for Regional Cooperation (SAARC). *Medicine*, *93*(13), e74. https://doi.org/10.1097/md.0000000000000074
8. Iqbal, A., Ahsan, K. Z., Jamil, K., Haider, M. M., Khan, S. H., Chakraborty, N., & Streatfield, P. K. (2021, June 26). Demographic, socioeconomic, and biological correlates of hypertension in an adult population: evidence from the Bangladesh demographic and health survey 2017–18. *BMC Public Health*, *21*(1). https://doi.org/10.1186/s12889-021-11234-5
9. NIPORT, I. (2020). Bangladesh demographic and health survey 2017-18. *Dhaka and Maryland*.

10. Rahman, M., Zaman, M. M., Islam, J. Y., Chowdhury, J., Ahsan, H. N., Rahman, R., Hassan, M., Hossain, Z., Alam, B., & Yasmin, R. (2017, December 11). Prevalence, treatment patterns, and risk factors of hypertension and pre-hypertension among Bangladeshi adults. *Journal of Human Hypertension*, *32*(5), 334–348. https://doi.org/10.1038/s41371-017-0018-x
11. Hashmi, S. K., Afridi, M. B., Abbas, K., Sajwani, R. A., Saleheen, D., Frossard, P. M., Ishaq, M., Ambreen, A., & Ahmad, U. (2007, March 14). Factors Associated with Adherence to Anti-Hypertensive Treatment in Pakistan. *PLoS ONE*, *2*(3), e280. https://doi.org/10.1371/journal.pone.0000280
12. Alam, D. S., Chowdhury, M. A. H., Siddiquee, A. T., Ahmed, S., & Niessen, L. W. (2014, December). Awareness and control of hypertension in Bangladesh: follow-up of a hypertensive cohort. *BMJ Open*, *4*(12), e004983. https://doi.org/10.1136/bmjopen-2014-004983
13. National Institute of Population Research and Training - NIPORT/Bangladesh, Mitra and Associates/Bangladesh, and ICF International. 2013. Bangladesh Demographic and Health Survey 2011. Dhaka, Bangladesh: NIPORT, Mitra and Associates, and ICF International. Available at http://dhsprogram.com/pubs/pdf/FR265/FR265
14. Hossain, F. B., Adhikary, G., Chowdhury, A. B., & Shawon, M. S. R. (2019, December). Association between body mass index (BMI) and hypertension in south Asian population: evidence from nationally-representative surveys. *Clinical Hypertension*, *25*(1). https://doi.org/10.1186/s40885-019-0134-8
15. Chowdhury, M. Z. I., Rahman, M., Akter, T., Akhter, T., Ahmed, A., Shovon, M. A., Farhana, Z., Chowdhury, N., & Turin, T. C. (2020, June 1). Hypertension prevalence and its trend in Bangladesh: evidence from a systematic review and meta-analysis. *Clinical Hypertension*, *26*(1). https://doi.org/10.1186/s40885-020-00143-1
16. Liu, H., Yao, J., Wang, W., & Zhang, D. (2017, June 13). Association between duration of oral contraceptive use and risk of hypertension: A meta-analysis. *The Journal of Clinical Hypertension*, *19*(10), 1032–1041. https://doi.org/10.1111/jch.13042
17. Antignac, M., Diop, I. B., Macquart de Terline, D., Kramoh, K. E., Balde, D. M., Dzudie, A., Ferreira, B., Houenassi, M. D., Hounsou, D., Ikama, M. S.,

Kane, A., Kimbally-Kaki, S. G., Kingue, S., Kouam, C., Limbole, E., Mfeukeu Kuate, L., Mipinda, J. B., N'Guetta, R., Nhavoto, C., . . . Jouven, X. (2018, April). Socioeconomic Status and Hypertension Control in Sub-Saharan Africa. *Hypertension*, *71*(4), 577–584. https://doi.org/10.1161/hypertensionaha.117.10512

18. Hasan, M., Khan, M. S. A., Sutradhar, I., Hossain, M. M., Hossaine, M., Yoshimura, Y., Choudhury, S. R., Sarker, M., & Mridha, M. K. (2021, January). Prevalence and associated factors of hypertension in selected urban and rural areas of Dhaka, Bangladesh: findings from SHASTO baseline survey. *BMJ Open*, *11*(1), e038975. https://doi.org/10.1136/bmjopen-2020-038975
19. Steffen, M., Kuhle, C., Hensrud, D., Erwin, P. J., & Murad, M. H. (2012, December). The effect of coffee consumption on blood pressure and the development of hypertension. *Journal of Hypertension*, *30*(12), 2245–2254. https://doi.org/10.1097/hjh.0b013e3283588d73
20. Gando, Y., Sawada, S. S., Kawakami, R., Momma, H., Shimada, K., Fukunaka, Y., Okamoto, T., Tsukamoto, K., Miyachi, M., Lee, I. M., & Blair, S. N. (2018, October 23). Combined association of cardiorespiratory fitness and family history of hypertension on the incidence of hypertension: a long-term cohort study of Japanese males. *Hypertension Research*, *41*(12), 1063–1069. https://doi.org/10.1038/s41440-018-0117-2
21. O'Donnell, C. J., Ridker, P. M., Glynn, R. J., Berger, K., Ajani, U., Manson, J. E., & Hennekens, C. H. (1997, March 4). Hypertension and Borderline Isolated Systolic Hypertension Increase Risks of Cardiovascular Disease and Mortality in Male Physicians. *Circulation*, *95*(5), 1132–1137. https://doi.org/10.1161/01.cir.95.5.1132

Appendix

Questionnaire:

Determinants of hypertension: awareness, treatment and control among adults in Dhanmondi

1. **Name**:
2. **Gender**: □ Male □ Female
3. **Age**:
4. **Religion**: □ Islam □ Hindu □ Other
5. **Marital status**: □ Married □ Unmarried □ Divorced □ Widowed
6. **Education**: □ Illiterate □ Primary □ Secondary □ Higher
7. **Housing Condition**: □ Slum □ Apartment (Rent) □ Apartment (Own)
8. **Number of family member under this household**:
9. **Currently Working**: □ Yes □ No
10. **Income**: □ Below 5K □ 5k-10K □ 10K-20K □ 20K-50K □ Above 50K
11. **Height (in cm)**: ____________________
12. **Weight (in kg)**: ____________________
13. **Family history of Hypertension**: □ Yes □ No
14. **History of heart disease**: □ Yes □ No
15. **Having any major disease (If yes mention)**: ______________________

16. **Smoking status**: □ Yes □ No

17. **Alcohol consumption**: □ Yes □ No

18. **Coffee intake in a Day**: □ ≤ 3 Cups □ > 3 Cups □ No

19. **How many hours do you sleep?** ______________________

20. **Hours of walking per day** □ ≤ 30 Minutes □ > 30 Minutes

21. **Do you follow any diet schedule** □ Yes □ No

22. **Pulse rate**: ____________________

23. **Blood pressure**: ____________________

24. **Taking regular check-up** □ Yes □ No

25. **Medication for Hypertension** □ Yes □ No

26. **If Hypertensive, reasons for not taking medications**: